BULL. BOT. SURV. INDIA
Vol. 8, No. 1 : pp. 60-67, 1966

ECOLOGICAL STUDIES OF SAURASHTRA COAST AND NEIGHBOURING ISLANDS: IV. PIRAM ISLAND

T. ANANDA RAO, K. R. AGGARWAL AND A. K. MUKHERJEE
Botanical Survey of India, Calcutta

ABSTRACT

The Plant ecology of Piram, a small narrow off shore island situated 21°36′ : 72°21′ in the Gulf of Cambay is presented in this paper. Based on habitat, substratum and edaphic features the plant communities of the island have been distinguished into 7 main categories under three vegetational zones. 74 species are enumerated and the flora resembles the one on mainland. The first ecologically annotated list of Vascular plants will form a background for a study of future changes.

LOCATION AND GENERAL DESCRIPTION

Piram, a small narrow off shore island is situated at 21°36′N and 72°21′E in the Gulf of Cambay. It lies about 7 miles (11 km) south of Gogha, a port in the District Bhavnagar of Saurashtra and 2.5 miles (4 km) from the nearest part of the shore but the easiest approach to the island is from Gogha port. It is a reef of rock covered in part by brown sand, its dimensions at high water being one mile (1.6 km) by about half a mile (0.8 km) and covers an area of 320 acres (128 hectares). Except on the south it is surrounded by rocky reefs rising to the surface from a depth of 60 to 70 feet (18.5-21.5 m).

The surface of the island which is partly drift sand and partly a light arable soil rises on the west side into low cliffs of hardened clays and conglomerates. On a sandy knoll in the centre of the island is a light house. Its large store of fossils gives a special importance to Piram. Besides masses of petrified wood, large quantities of animal remains were found in the year 1836. Almost all were embedded in the rock in the south-east corner of the island, where the sea washes bare the lower conglomerate. The remains are the same as those of upper Sind and of the Siwalik hills. Besides two titanic ruminants, apparently with no living types, named the Bramatherium and the Sivatherium, there are species of elephant, rhinoceros, hippopotamus, horse, ox, antelope, several forms of crocodile, fresh water tortoises and fish of gigantic size.

The island is generally inhabited by two or three employees of the Light House Department and their families and a farmer and his family but during our exploration trips to the island some labour engaged in the construction of the Light House and staff quarters for the Light House employees, was residing there temporarily. A few hundred heads of goat are also brought to the island after the monsoon for about 3 months. They are grazed on the natural flora of the island. In addition wild oxen of whom only a few are left now, are also present.

CLIMATE

The climate of this island is recognised as semi-arid. Mean annual rainfall recorded by the nearest meteorological observatory at Bhavnagar based on observations for 50 years (1891-1940) is 22.09 inches (561 mm). A major portion of this precipitation comes in June to September i.e., during the months of the south-west monsoon and a long dry spell follows. Annual means of daily maximum and minimum temperature of 93.5°F and 69.0°F respectively are quite high. Relative humidity also remains high throughout the year. Distribution of rainfall during different months of the year and mean temperatures are represented by the histogram and a curve respectively in Fig. 1. Scrub vegetation and the seasonal flora of the island evidently has a bearing on the climate prevailing there. Vegetation of the other habitats is influenced in addition by factors such as tides, wave action, sea winds, saline water and the nature of the substratum.

GEOLOGY, SOILS AND RELATED FEATURES

Tertiary rocks of the lower Miocene age which have been correlated with the *Gaj Beds* (of Sind) are exposed in the island. A remarkable assemblage of mammalian remains (Mid. Siwalik) are found in these beds. Limonitic limestone, sand stone, grit, conglomerates, yellowish clays and marls are the common constituents of these beds. Clays and marls are interspersed with gypsum.

Exposed hard rock hallowed into caverns by sea water is visible all round the coast except on the south and south-eastern portion of the island. The area on the southern side when bare presents a muddy appearance sheltering the mangrove thickets of *Avicennia* sp. With the deposition of mud on the underlying rock this mangrove depression is extending to south-eastern and even to the eastern side of the island. A small portion on the northern side gets occasional inundation with sea water and generally presents dry muddy appearance. Grasses and sedges typical of the salt marsh are supported in this zone. Foreshore on the northern side is followed by sand mounds of light brown colour and as they extend to the interior, grow in stature and have attained a height of 30-40 ft (9-12 m) in some cases. These mounds are well covered by the sand binding plants and are thus stabilised to a great extent. A *talav* holding fresh water during the wet season extending to a distance of about 500 ft (150 m) is present in between these sandy mounds. This *talav* at no time gets inundated with sea water. Where the fine sand is present more or less in the form of sandy flats down the light house area and in the interior, a characteristic physiognomy is given to the habitat with the appearance of scrub forests. In the eastern side of the island where a good arable soil is present, the land is cultivated with millets and ground nut but the produce from this land is entirely dependent on rainfall.

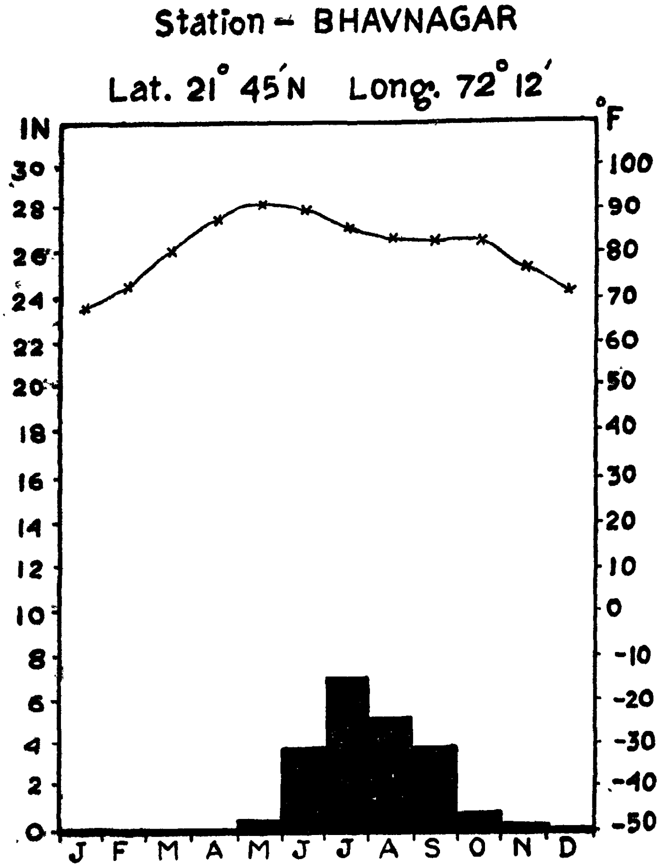

Fig. 1. Histogram showing distribution of Rainfall and Temperature Curve

METHODS

Three exploration tours were undertaken during different seasons of the years 1963-64 and the field data collected for the floristic composition. Soil samples were collected from different habitats in the island and analysed in the laboratory for their physical and chemical characteristics to study the vegetation in relation to soils, following the methods of Rao *et al* (1963).

VEGETATION

The vegetation based on the nature of the habitat, substratum and edaphic features is studied under the following distinct heads:

1. Rocky foreshore; 2. Mangrove depression; 3. Salt marsh; 4. Sandy mounds; 5. *Talav* in-between sandy mounds; 6. Scrub forest and 7. Man-made habitat (cultivated fields).

1. Rocky Foreshore: All round the coast of the island hard rock, either calcareous sandstone or calcareous conglomerate, is exposed except in the south and south-eastern portions. The rock is hollowed into caverns or crannies due to the extreme force of the sea water. This hard rock is continued well within the sea and rock out-crop quite far off from the island is seen during low tide. For the first time, the presence of *Enhalus acoroides* a member of Hydrocharitaceae is located near Piram island, which was found to extend in the rocky coasts of Gopnath, Mahuva, Victor port, and Jafarabad along the Gulf of Cambay of Saurashtra coast. No other vegetation is seen except the algal flora in the rocky caverns where some water is left during low tide. Due to deposition of some mud in portions of this habitat some *Avicennia* seedlings transported from the mangrove habitat are establishing themselves and as the deposition of mud increases it is likely that this area after sometime will be converted into a mangrove forest of *Avicennia* provided there is no biotic interference.

2. Mangrove Depression: The area on the southen side which presents a muddy habitat when bare is occupied by the mangrove thickets. *Avicennia* sp. is the only plant of the habitat and the presence of its bushes is restricted to a small patch at the moment. However, some seedlings by water drift have established themselves in the south-eastern muddy area also and are attaining the size of bushes. Further, even in the rocky muddy

area on the western foreshore *Avicennia* seedlings are seen, and it will be no wonder if the mangrove zone extends to other parts of the island with the deposition of more mud and develops into a good forest, povided the biotic interference is kept to the minimum possible.

Light grey coloured sandy loam soil from the mangrove depression is mildly alkaline. It contains 1.74% of organic matter. Total dissolved solids and sodium chloride contents of the soil are very high as a result of the habitat being under sea water. The soil is calcareous (Table I,i).

3. SALT MARSH: This is a small patch of land on the northern shore of the island. This depression comparatively on a raised level from the foreshore gets occasional inundation with sea water during high tide and generally the soil is moist and rich in salts. The excess of salts helps in the preservation of moisture in the soil which in fact never gets dried up. Grasses and sedges typical of saline habitats are supported in this zone. *Aeluropus lagopoides* is the most abundant and common plant of this zone.

The soil from the salt marsh, very light grey in colour is sandy loam. The pH value of the soil indicates neutrality. It contains 1.41% of organic matter. Total dissolved solids and sodium chloride contents suggest that the habitat is under the influence of sea water. The soil is calcareous with $CaCO_3$ content of 7.60% (Table I,ii).

4. SANDY MOUNDS: Rocky foreshore on the northern, north-eastern, north-western and south-western sides of the island is followed by sandy mounds. The sandy mounds are formed from fine light brown coloured drift sand which invariably contains good concentrations of heavy mineral particles such as magnetite, ilmenite and garnet. Concentration of these heavy mineral particles is very high immediately adjacent to the rocky foreshore and is responsible for imparting almost black colour to the sand lying there. These sandy mounds extend well within inland and grow in size towards the interior, attaining a height of 30-40 ft (9-12 m) in some cases. The concentration of heavy mineral particles decreases in the sands of these mounds towards the interior because of the fact that wind has carried away the sand particles from the foreshore but has left the heavier particles there. As the conditions stand at present there is very little drift of sand and the mounds are practically stabilised by the spread of sand binding plants.

Sparcely distributed along the fringes of the sandy mounds especially towards sea-side sandy spots or foredunes is *Ipomoea pes-caprae*. The vegetal cover of the consolidated back dunes, consists of *Leptadenia pyrotechnica, Capparis decidua, Calotropis procera, Saccharum spontaneum, Lycium barbatum, Aerva javanica, Borreria articularis, Cenchrus barbatus* and *Psilostachys sericea.* In addition to the above plants one could see on the back dunes sloping towards the inland *Achyranthes aspera, Triumfetta rhomboidea, Xanthium strumarium, Digera muricata, Pupalia lappacea, Tribulus terrestris, Aristida funiculata, Pedalium murex, Volutarella divaricata, Echinops echinatus, Tridax procumbens, Cassia tora* and *Trichodesma indicum.*

Soils from the sandy mounds are sand to sandy loam. The pH values of the samples indicate mild to moderate alkalinity. There is a wide variation in the organic matter contents of the samples which ranges between 0.01-2.28% depending upon the nature and density of the vegetal cover. Total dissolved solids and sodium chloride contents are low. All the soils are highly calcareous (Table I,iii).

5. 'TALAV' AND CIRCUM-AREAS: In between the sandy mounds on the northern shore a depression extending to 400-625 ft (125-175 m) is present. This depression on a raised level from the sea at no time gets inundated by sea water. On the other hand it holds fresh water during rainy season and is converted into a 'Talav' or slack. Seasonal flora in the form of grasses and forbs is supported on the fringes of this 'Talav'. The commonly occurring plants of this area are *Abutilon indicum, Zizyphus nummularia, Eclipta prostrata, Cyperus tegetum, Ammannia baccifera, Chloris virgata, Euphorbia hirta, Cyanotis axillaris* and *Cynodon dactylon.*

6. SCRUB FOREST: Where the fine sand is present more or less in the form of sandy flats adjacent to the sandy mounds and in the interior, a characteristic physiognomy is given to the habitat with the appearance of scrub forests. However, due to the biotic interference in the form of indiscriminate cutting, felling and grazing by the animals their growth is restricted and they have not developed into good forests. A few acres of land have also been cleared for cultivation. *Acacia nilotica* is the dominating community. Its chief associates are *Maytenus emarginata, Prosopis glandulosa* and *Grewia tenax.* Wherever there is partial clearing, one could see the preponderance of *Cassia tora, Sida cordifolia, Tephrosia purpurea, Indigofera pauciflora, Panicum antidotale* and *Apluda mutica.* The other commonly seen forbs are *Polycarpaea corymbosa, Eincostema littorale, Trichodesma indicum* and

Crotalaria medicaginea. Sometimes the marginal areas are covered with *Cordia* spp., *Aloe* and strand climbers like *Clitoria ternatea, Teramnus labiales, Pergularia daemia* and *Pentatropis microphylla,* often growing on *Acacia* or *Cordia* spp.

Soils from the scrub forests are sand to loamy sand. They are mildly to moderately alkaline. The pH value of sample No. 603, however, is very near to the neutral. It seems that the high organic matter content (4.60%) of this sample is responsible for lowering the pH. Total dissolved solids and sodium chloride contents of all the samples are low. All the soils are calcareous.

One profile upto the hard stratum was studied. This is represented by sample Nos. 608-610. It is seen that the percentage of clay as well as silt increases, organic matter, total dissolved solids and sodium chloride contents decrease with depth in the profile (Table I,iv).

7. MAN-MADE HABITAT: They are chiefly represented by cultivated fields and bunds. In the eastern part of the island a light arable soil is present in a good condition. Millets such as *Jowar* and *Bajra* and groundnut are grown in this land. It is reported that even wheat is grown in some years but the good production of crops is entirely dependent on rainfall.

The bunds support mostly weeds like *Cardiospermum halicacabum, Alysicarpus longifolius, Crotalaria medicaginea* and climbers like *Aristolochia bracteolata, Blastania garcinii* and *Coccinia* sp.

Soils from cultivated fields are deep brown in colour, sand to sandy loam in texture and formed by the *in-situ* weathering of the underlying rock. The pH values indicate moderate alkalinity. Organic matter contents of the soils are 1.10 and 1.23%. Total dissolved solids and sodium chloride contents of the soils are low and they are calcareous (Table I,v).

CONCLUSIONS

The flora amounts to 74 species spread over into 32 families, and do not differ from that of main costal hinterland. The analysis of the vegetation reveals that the flora do not resemble that of an oceanic island. The evidence all points, therefore, to the island being connected with the mainland. The island is exposed to tidal bores and one could see the changing shore line almost all round the island. Besides the island is lacking any specialised littoral flora or coastal flora as sometimes seen in such off shore islands like Krusadi islands near Rameswaram island (Rao *et al,* 1963, 1964). The coastal plants of Persio-Arabian elements as seen in other off shore islands and coasts of Saurashtra (Rao *et al,* 1964) are not seen in this island. Some of the interesting wild plants of coastal hinterland like *Sericostoma pauciflora, Typha angustiata, Commiphora roxburghii, Euphorbia nivulia, Polycarpaea spicata* are not seen in this island. The point of interest is the frequent occurrence of *Psilostachys sericea;* a member of Amaranthaceae on coastal sandy mounds and its recorded occurrence in some new localities of Saurashtra coast especially near Port Victor Albert (Rao *et al,* in press) and Somnath (Rao & Safui, 1963). Recently it has been reported from Bombay coast near Juhu (Shah, 1964).

The vegetation as available in this island needs protection from felling, grazing and ploughing. With increased biotic activity the island's flora will be deflexed and in future, the disappearance of sturdy woody species which are very few in number would prove fatal to the very existence of the island. Therefore, it can reasonably be concluded that every effort should be made to protect the existing vegetation especially the internal scrubland from further distortion.

ECOLOGICALLY ANNOTATED LIST OF THE VASCULAR FLORA

CAPPARIDACEAE

Capparis decidua (Forsk.) Edgew.

Characteristic on the margin of lee side of sandy mounds. Tolerant of salt spray and exposure. *A. K. Mukherjee* 2214; *Rao* 2052.

CARYOPHYLLACEAE

Polycarpaea corymbosa (L.) Lamk.

Occasional to frequent in the marginal scrubland. Good growth form under shade of its associates. *Rao* 2019.

MALVACEAE

Sida cordifolia L.

Frequent in and around scrubland. *Rao* 2036; *A. K. Mukherjee* 2210.

Abelmoschum moschatus Medic.

Exposed areas; occasional to frequent. *Rao* 2053.

Abutilon indicum Sweet.

Dominant over small areas which are less densely shaded. *Rao* 2074.

Urena lobata L.

Shady areas. *Rao* 2021.

TILIACEAE

Grewia tenax (Forsk.) Fiori
Sub-dominant sturdy plants. *Rao* 2048.

Corchorus olitorius L.
Frequent in swales. Common near the water edge. *Rao* 2033.

Triumfetta rhomboidea Jacq.
Inland type. Locally abundant near the water and in shady places. *Rao* 2069.

ZYGOPHYLLACEAE

Tribulus terrestris L.
Frequent on sandy plains and exposed sandy slopes. *Rao* 2040.

CELASTRACEAE

Maytenus emarginata (Willd.) Ding Hoil.
Sub-dominant sturdy plant plentiful in scrubland area. *Rao* 2012.

RHAMNACEAE

Zizyphus sp.
Few small trees. *Rao* 2043.

SAPINDACEAE

Cardiospermum halicacabum L.
Weed of cultivation on the bunds. *Rao* 2049.

LEGUMINOSAE

Tephrosia purpurea Pers.
Dominant in exposed inland sandy field. *A. K. Mukherjee* 2209; *Rao* 2015, 2071.

Prosopis glandulosa Tour.
Few small trees. *A. K. Mukherjee* 2217.

Acacia nilotica (L.) Del.
Dominant scrubland climax community. *Rao* 2010, 2042.

Alysicarpus longifolius (Rottl.) Wt. & Arn.
Weed of cultivation on bunds. *Rao* 2023, 2029.

Cassia tora L.
All over exposed scrubland. *Rao* 2024.

Clitoria ternatea L.
Strand climber. Margin of scrubland. *Rao* 2028.

Crotalaria medicaginea Lamk.
Inland area. Scrubland margin. Dominant in patches. *Rao* 2073, 2038.

Desmodium diffusum (Willd.) DC.
Near arable lands. *Rao* 2023.

Indigofera sp.
Scrubland zone. Exposed sandy areas. *Rao* 2038, 2072.

Teramnus labialis (L. f.) Spr.
Strand climber. Margin of scrubland. *Rao* 2027.

LYTHRACEAE

Ammannia baccifera L.
Near Talav. Exposed areas near water. *Rao* 2044.

CUCURBITACEAE

Blastania garcinii (L.) Cogn.
Climber; margin of scrubland. *Rao* 2017.

Coccinia sp.
Climber in the heart of scrubland. *Rao* 2034.

RUBIACEAE

Borreria articularis (L. f.) F. N. Will.
Leeside of sandy mounds. Tolerates exposure and salt spray. *Rao* 2078.

COMPOSITAE

Vernonia cinerea Less.
Swale zone. Frequent near the water edge of 'Talav'. *Rao* 2054.

Xanthium strumarium L.
Good patches on sandy exposed areas. *Rao* 2039.

Volutarella ramosa (Roxb.) Sant.
Exposed sandy slopes of Leeside. *A. K. Mukherjee* 2201.

Echinops echinatus DC.
Exposed sandy slopes of Leeside. *A. K. Mukherjee* 2211.

Tridax procumbens L.
Sandy slopes and swales. *Rao* 2050.

Eclipta prostrata L.
Frequent near the water edge of 'Talav'. *Rao* 2020.

Sonchus sp.
Exposed marginal erroded marginal zone. *Rao* 2047.

ASCLEPIADACEAE

Calotropis procera R. Br.
Crest of sandy mounds, frequent on the Leeside. *Rao* 2013.

Pergularia daemia (Forsk.) Chiov.
Strand climber margin of scrubland. *Rao* 2014.

Pentatropis microphylla Wt. & Arn.
Margin and interior of scrubland. Open areas. *Rao* 2026.

Leptadenia pyrotechnica (Forsk.) Dcne.
Dominating community on the slopes of sandy mounds. Frequently on leeside. *Rao* 2063; *A. K. Mukherjee* 2205.

GENTIANACEAE

Enicostema littorale Bl.
Marginal sandy areas. Tolerates salt spray and sometimes becomes succulent. *Rao* 2045.

BORAGINACEAE

Cordia sp.
Marginal areas of scrubland. *Rao* 2051.

C. myxa L.
Few fair-sized tree. Marginal areas of scrubland. *Rao* 2061.

C. rothii Roem. & Schult.
Sturdy plants on exposed marginal areas of scrubland. *Rao* 2009.

Trichodesma indicum R. Br.
Sandy moist spots. *Rao* 2079.

CONVOLVULACEAE

Ipomoea pes-tigridis L.
A climber in the interior of scrubland. *Rao* 2008.

I. pes-caprae (L.) Sweet
Pioneer at the foot of foredunes and sandy beaches. *Rao* 2018; *A. K. Mukherjee* 2208.

SOLANACEAE

Lycium barbatum L.
Leeside of sandy mounds. *A. K. Mukherjee* 2216.

PEDALIACEAE

Pedalium murex L.
Heel of sandy mounds and sandy plains. *Rao* 2032.

ACANTHACEAE

Barleria prionitis L.
Marginal exposed rocky crevices. *Rao* 2041.

VERBENACEAE

Avicennia marina var. **acutissima** Stapf & Moq.
Muddy deposits on rocky surface. Littoral zone. *Rao* 2062.

LABIATAE

Ocimum canum Sims
Internal scrubland. *Rao* 2046, 2080; *A. K. Mukherjee* 2215.

NYCTAGINACEAE

Boerhavia diffusa L.
Leeside of sandy mounds. *Rao* 2078.

AMARANTHACEAE

Achyranthus aspera L. var. **porphyristachya** Hook. f.
Sandy mounds especially near the swales. *Rao* 2022.

Aerva javanica Juss.
Sandy slopes of leeside. *A. K. Mukherjee* 2207; *Rao* 2068.

Digera muricata (L.) Mart
Weed of cultivation on bunds. *Rao* 2037.

Pupalia lappacea (L.) Juss.
Frequent amidst bushes of scrubland. Tolerates shade. *Rao* 2055.

Psilostachys sericea (Koen. ex Roxb.) Hook. f.
A very interesting small plant on sandy mounds. This plant is reported to have been collected by Raojee in 1883. Subsequently this plant is found growing by the writers near the coastal areas of Somnath, Port Victor Albert and recently by Shah (1964) near Juhu (Bombay). Intensive exploration along the Western coast of India may reveal other localities for this interesting plant.

ARISTOLOCHIACEAE

Aristolochia bracteolata Lamk.
Climber on hedges. *A. K. Mukherjee* 2206, 2212.

EUPHORBIACEAE

Euphorbia hirta L.
Swales and exposed open sandy spots. *Rao* 2078.

CASUARINACEAE

Casuarina equisetifolia L.
Cultivated. A few fair sized trees.

HYDROCHARITACEAE

Enhalus acoroides (L. f.) Rich. ex Steud.
Littoral zone. (not collected)

LILIACEAE

Aloe vera L.
Marginal erroded coast. *Rao* 2027.

COMMELINACEAE

Commelina communis L.
Shaded scrubland. *Rao* 2016.

Cyanotis axillaris (L.) Schult. f.
Shaded scrubland. *Rao* 2031.

PALMAE

Borasus flabellifer L.
Fair sized tree only two. (not collected)

GRAMINEAE

Aeluropus lagopoides (L.) Trin. ex Thw.
Dry elevated area. Occasionally subjected to tidal wave action. *A. K. Mukherjee* 2213.

Apluda mutica L.
Frequent all along hedges in scrubland. *Rao* 2067.

Cenchrus biflorus Roxb.
Leeside of sandy mounds and sandy spots. *Rao* 2064.

Chloris virgata Sw.
Near watery edges. *Rao* 2057.

Eragrostis sp.
Swales and sandy spots. *Rao* 2058.

Saccharum spontaneum L.
Leeside of sandy mounds. *Rao* 2059.

Panicum antidotale Retz.
Partially shaded scrubland. *Rao* 2060, 2065; *A. K. Mukherjee* 2204, 2011.

Aristida funiculata Trin. et Rupr.
Swales and slopes of sandy mounds. *Rao* 2056.

TABLE I

ANALYSIS OF SOIL SAMPLES COLLECTED WITHIN PIRAM ISLAND

Soil sample No.	Location	Depth of sampling cm	Vegetation cover	Soil colour	Mechanical composition Clay %	Silt %	Fine sand %	Coarse sand %	Soil texture	pH	Organic matter %	T.S.S. %	NaCl %	CaCO$_3$ %
	i. *Mangrove depression*													
604	Eastern side under *Avicennia* seedlings	0—10	*Avicennia* spp.	light grey	5.55	48.20	46.25	—	sandy loam	7.8	1.74	3.8475	2.984	7.97
	ii. *Salt Marsh*													
602	Northern side	0—10	*Aeluropus lagopoides*	very light grey	2.60	36.50	60.00	0.90	sandy loam	7.1	1.41	2.1150	1.720	7.60
	iii. *Sandy mounds*													
601	Northern side	0—10	*Leptadenia pyrotechnica*	blackish	0.10	1.65	95.05	3.20	sand	7.5	0.01	0.0350	0.044	8.42
605	North-eastern side	0—10	*Capparis decidua*	light brown	1.60	3.25	92.17	2.98	sand	8.2	2.28	0.1925	0.014	16.30
606	North-western side	0—10	*Psilostachys sericea*	-do-	0.90	1.15	59.96	37.99	sand	8.3	0.01	0.0650	0.014	20.81
607	North-western side	0—10	*Calotropis procera*	-do-	2.20	1.10	83.87	12.83	sand	8.3	0.41	0.0900	0.014	13.09
704	North-western side	0—10	*Pedalium murex*	dull brown	4.95	34.75	59.28	1.02	sandy loam	7.8	0.32	0.1550	0.014	19.86
	iv. *Scrub forest*													
603	Southern side	0—10	*Acacia nilotica*	light brown	1.30	13.90	75.88	8.92	loamy sand	7.1	4.60	0.5550	0.072	8.37
608	Inland scrub forest	0—15	*Tephrosia purpurea*	light grey	2.25	3.00	68.18	26.57	sand	8.4	1.17	0.2650	0.029	13.10
609		15—45		-do-	2.35	8.65	74.74	14.26	sand	8.5	0.41	0.2100	0.029	32.41
610		45—75		-do-	6.95	17.85	63.63	11.57	loamy sand	8.5	0.33	0.1300	0.014	10.10
705	Eastern side	0—10		deep brown	24.60	14.05	48.80	12.55	sandy clay loam	7.5	0.90	0.0350	0.014	21.81
	v *Arable land*													
702	Eastern side	0—10	Bajra and Jowar crop	-do-	1.70	8.10	77.43	12.77	sand	8.2	1.10	0.2400	0.014	14.55
703	Eastern side	0—10	Ground-nut crop	-do-	1.25	25.60	55.20	17.95	loamy sand	7.8	1.23	0.2600	0.014	9.26

SUMMARY OF *TOPOGRAPHIC CONDITIONS* IN PIRAM ISLAND

Units	Topographic zones	Landforms	Topographic facets	Vegetation
1.	Shore	A. Foreshore	1. Sandy spots	*Ipomoea pes-caprae*
			2. Rocky spots with muddy deposits	*Avicennia*
		B. Backshore	3. Rocky sites	Algae ; *Enhalus acoroides*
2.	Dunes (Consolidated)	C. Foredune	4. Seaward slope	-nil-
			5. Crest	-nil-
			6. Heel	*Ipomoea pes-caprae*
		D. Backdune	7. Crest	*Calotropis procera*
			8. Slope	*Leptadenia pyrotechnica* *Lycium barbatum* *Saccharum spontaneum* *Aerva javanica* *Psilostachys sericea* *Borreria articularis*
			9. Heel	*Indigofera cordifolia* *Xanthium strumarium* *Pedalium murex* *Cassia tora*
			10 Swale	*Aristida funiculata* *Tridax procumbens* *Trichodesma indicum* *Cenchrus biflorus*
	Slacks	E. Depression circum areas	11. Interdunal 'Talav'	*Cyperus tegetum* *Ammannia baccifera* *Eclipta prostrata* *Chloris virgata* *Abutilon indicum* *Cynodon dactylon*
	Inland	F. Undulating terrain	12. Outer 13. Middle 14. Inner	*Acacia nilotica* *Maytenus emarginata* *Prosopis glandulosa* *Grewia tenax* and Seasonal forbs.
		G. Arable land	15. Plain	Bajra Jowar Ground nut and Weeds

Pennisetum typhoides (Burm.) Stapf et Hubb.

Cultivated a good crop tolerates salinity to a great extent. *Rao* 2066.

Cynodon dactylon (L.) Pers.

Margin of swales, and scrubland. *Rao* 2037.

ACKNOWLEDGMENT

The authors are very grateful to Dr. H. Santapau, Director, Botanical Survey of India, Calcutta for his encouragement during the course of these studies.

LITERATURE CITED

ANONYMOUS. *Imperial Gazetteer of India*. Vol. XX. Clarendon Press, Oxford, 1908.

—— *Gazetteer of the Bombay Presidency*. Vol. VIII. Govt. Central Press, Bombay, 1884.

—— *Climatological Tables of observatories in India*. India Meteorological Department, the Manager of Publications, Delhi, 247-48, 1953.

RAO, T. A., K. R. AGGARWAL AND A. K. MUKHERJEE. An ecological account of the vegetation of Rameswaram Island. *Bull. bot. Surv. India* 5: 301-323, 1963.

—— Ecological studies on the soil and vegetation of Krusadi group of islands. *Bull. bot. Surv. India* 5: 141-148, 1963.

RAO, T. A. AND K. R. AGGARWAL. Ecological studies of Saurashtra coast and neighbouring islands. I. Diu island. *Bull. bot. Surv. India* 6: 173-183, 1964.

—— Ecological studies of Saurashtra coast and neighbouring islands. II. Beyt island. *Bull. bot. Surv. India* 8: 16-24, 1966.

—— Ecological studies of Saurashtra coast and neighbouring islands. III. Okhamandal to Diu coastal area. *Arid Zone Symp.* 1964.

—— Ecological studies of Saurashtra coast and neighbouring islands. V. Bhavnagar to Diu coastal area. *Bull. bot. Surv. India* (in press).

RAO, T. A. AND B. SAFUI. Distribution of some rare plants along Saurashtra coast and neighbouring islands. *Proc. Indian Acad. Sci.* 58(B) : 362-366, 1963.

SHAH, G. L. A note on some rare plants of Bombay. *J. Soc. Indian For.* 4, 78-80, 1964.